Validation of OMI UV Radiances and Ozone Profiles with MLS Data

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AURA Validation Meeting 2007, Pasadena CA

October 3, 2007

Outline

- Motivation
- Validation of OMI UV radiances
- Intercomparison between OMI and MLS stratospheric ozone
- Tropospheric Ozone
- Summary

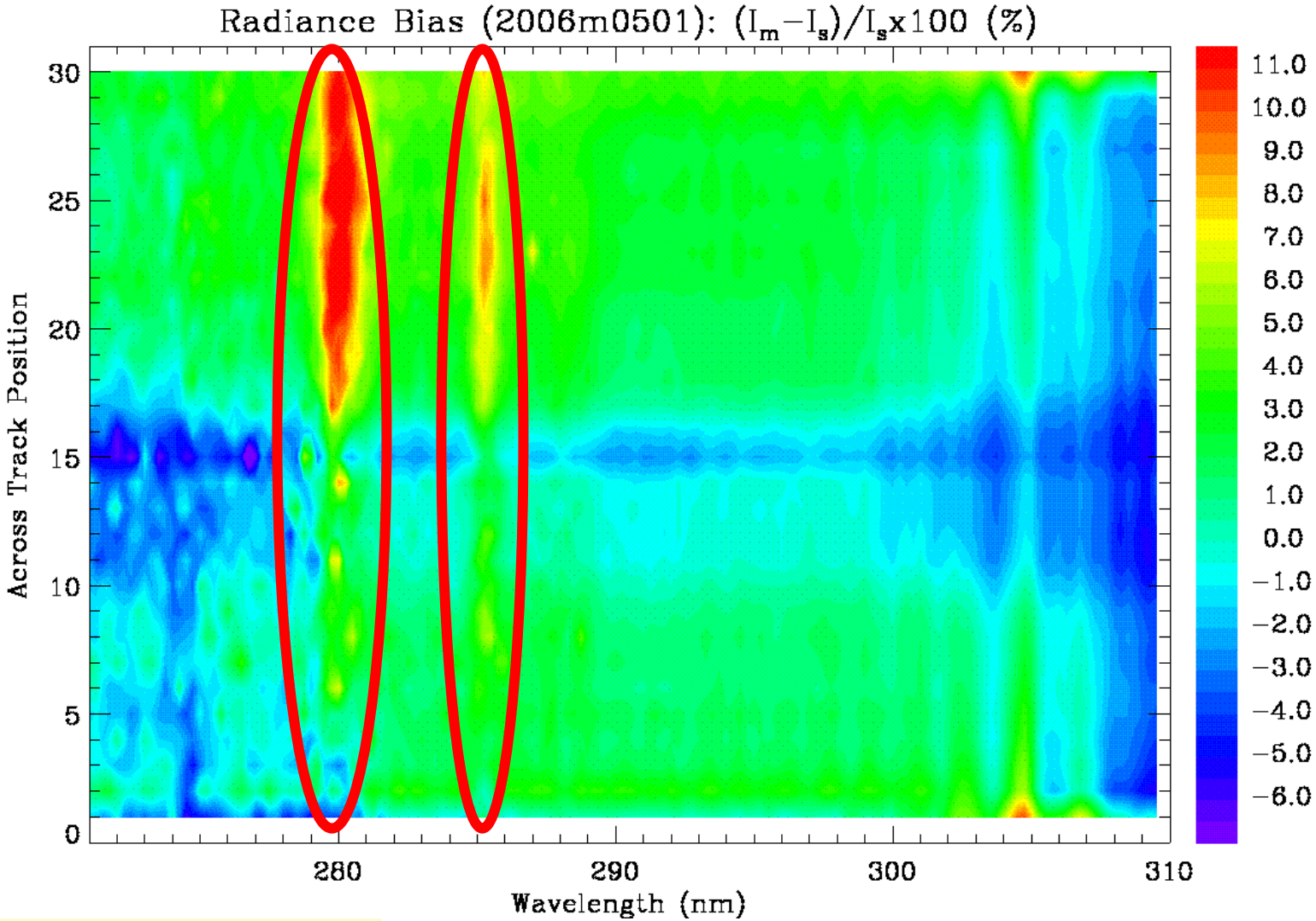
Motivation

- Applying our ozone profile and tropospheric ozone retrieval algorithm (Liu et al., 2005), originally developed for GOME, to OMI.
- Previous OMI ozone profile retrievals show across-track dependent biases.
- MLS: excellent source to validate OMI radiances and stratospheric ozone
  - MLS ozone has been extensively validated and is very well quality-controlled: ~5% in the stratosphere and ~10% at the lowest stratospheric altitudes, ~2% in stratospheric column ozone (Froidevaux et al., 2007)
  - Key to validating OMIPROF tropospheric ozone
  - Enough OMI/MLS coincidences

Validation of OMI UV Radiances

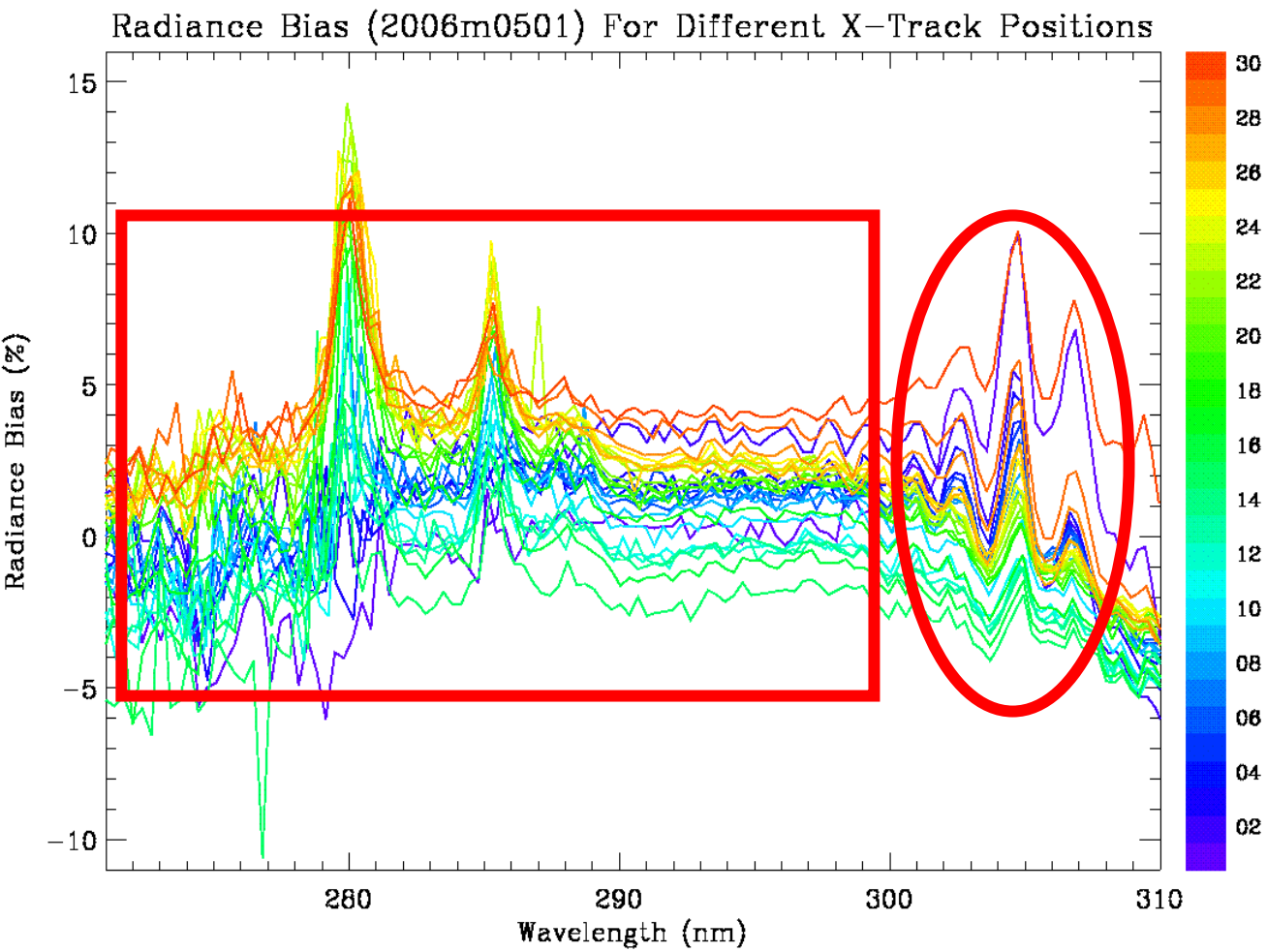
- Simulate OMI radiances (normalized) with VLIDORT
  - Zonal mean MLS (daily, V2.2, above 215 mb) + LLM Climatology (below 215 mb), normalized by zonal mean OMTO3 total ozone
  - OMICLDO2 (f_c and P_c)
  - 269-311 nm in UV1 and 309-335 nm in UV2
- Compare simulations with measured OMI radiances (Collection 3)
  - Remove the Ring effect by fitting a Ring spectra
  - Filter pixels with aerosol index <-1 or >1 and cloud fraction > 0.2
  - Select latitude bands (~20^o-band in the tropics) to avoid sun glint and large ozone variability
  - ~150,000 simulations for each day
  - 01/10/2006, 05/01/2006, 07/11/2006, and 10/15/2006 (similar results)

OMI Residuals (269-311 nm, 2006m0501, 20S-0)



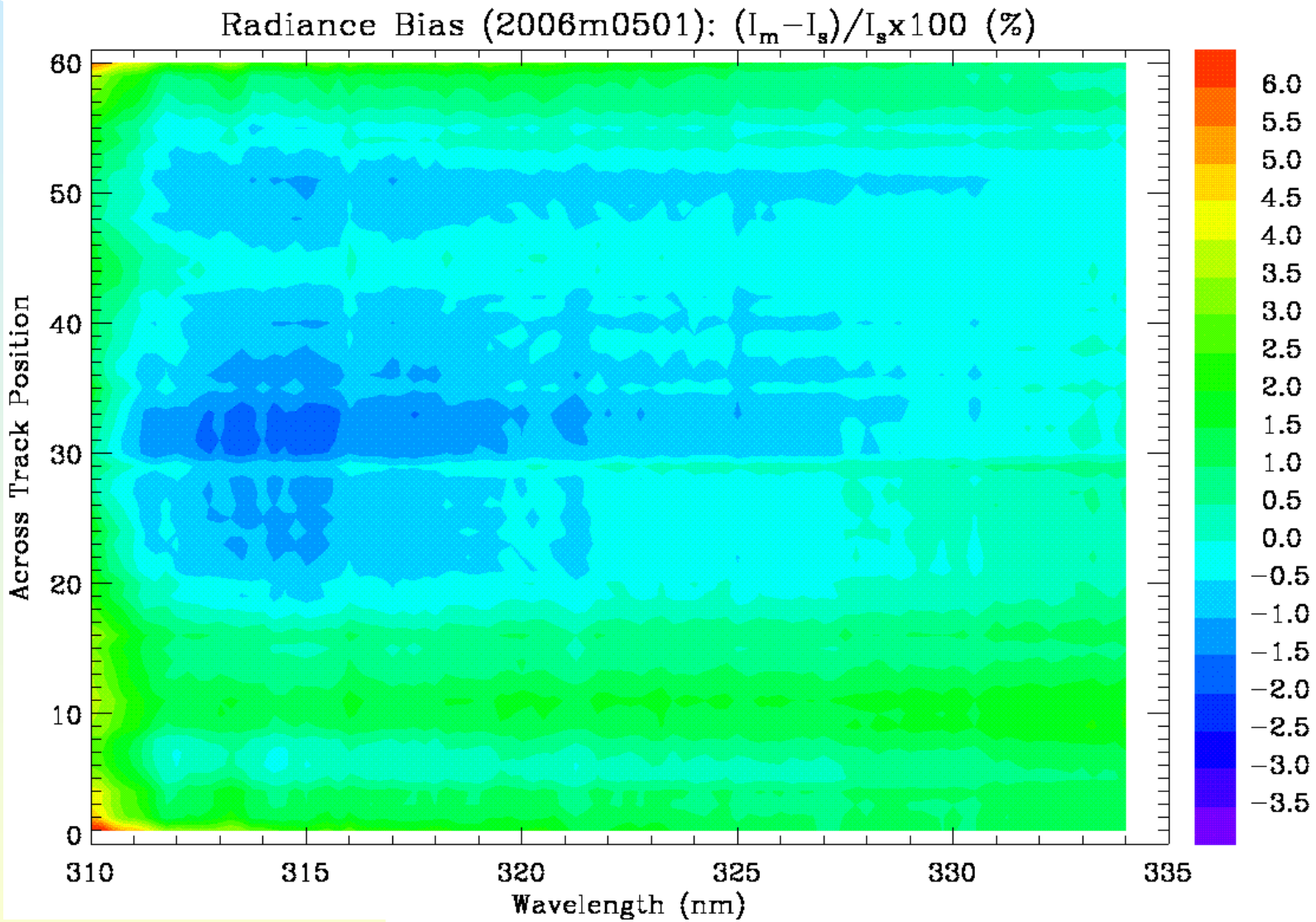
- Across-track and wavelength dependent variations
- 280, 285 nm: Mg^{+}/Mg emission lines and maybe calibration???

OMI Residuals (UV1)



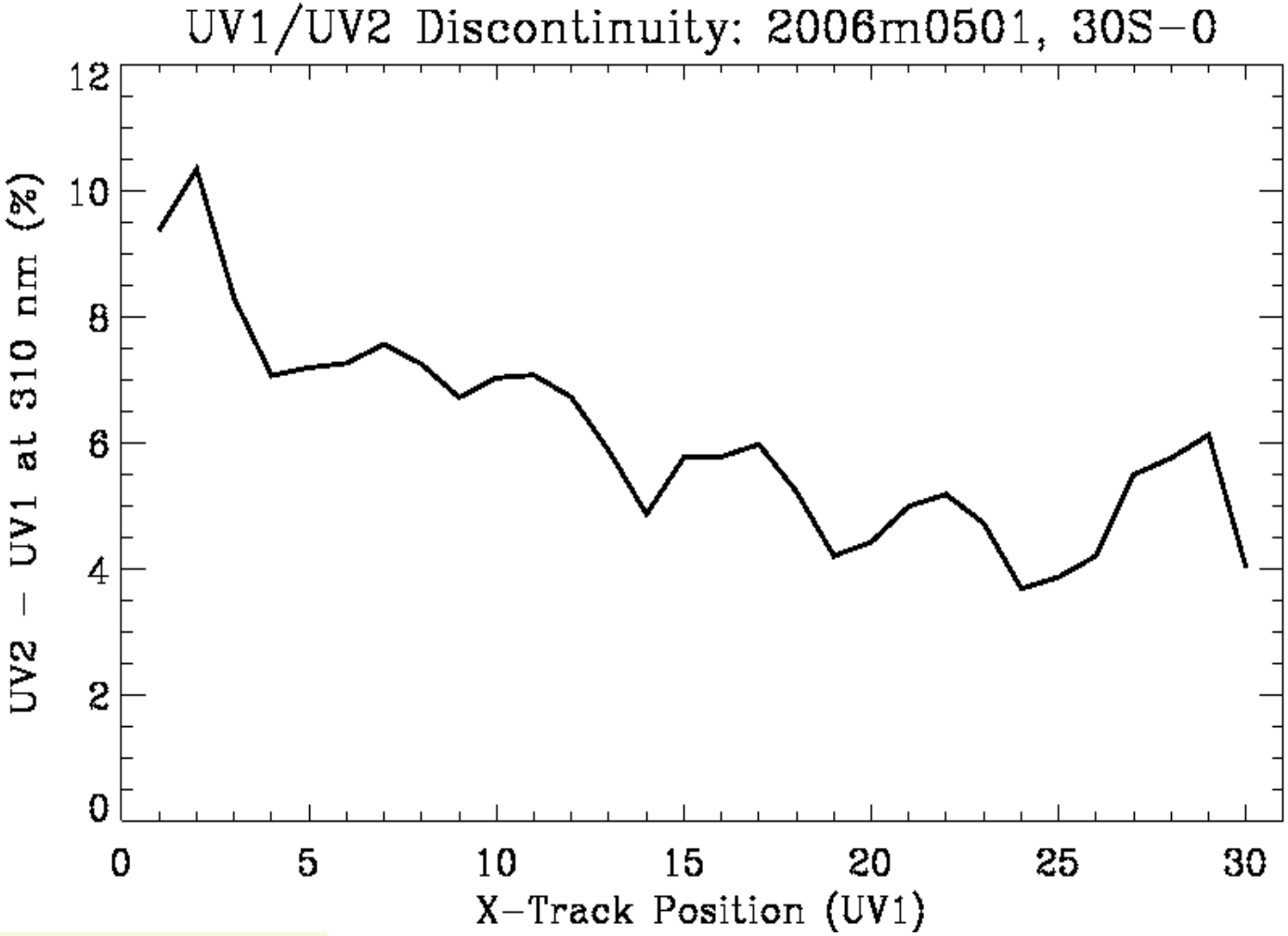
- **270-298 nm: Obvious across-track dependent biases (~6%)**
- **Above 300 nm: why high frequency structures???**

OMI Residuals (UV2, 309-335 nm, 2006m0501)



- Across-track and wavelength dependent variations

UV2/UV1 Discontinuity (2006m0501)



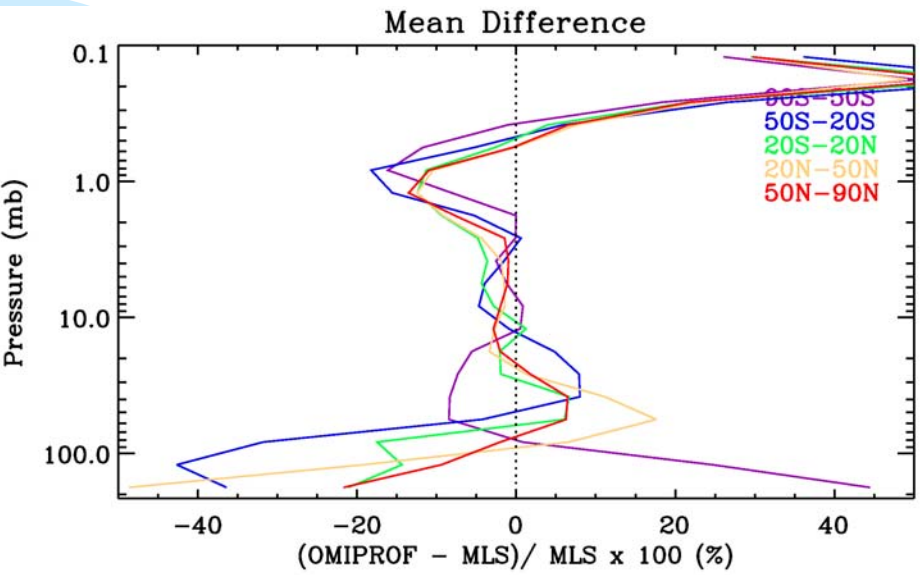
■ **UV1/UV2 discontinuity at 310 nm: 4-10% depending on across track position**

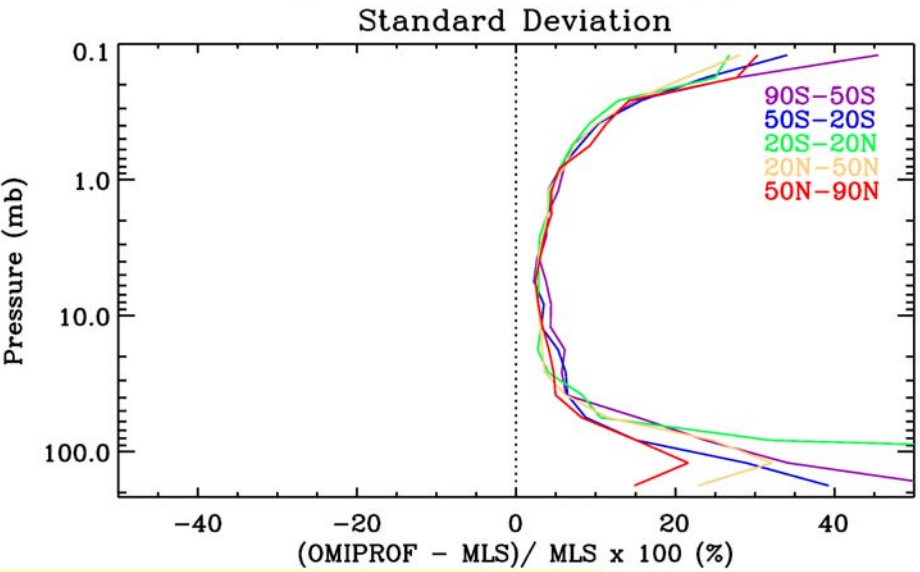
Ozone Profile Retrieval Algorithm and Validation

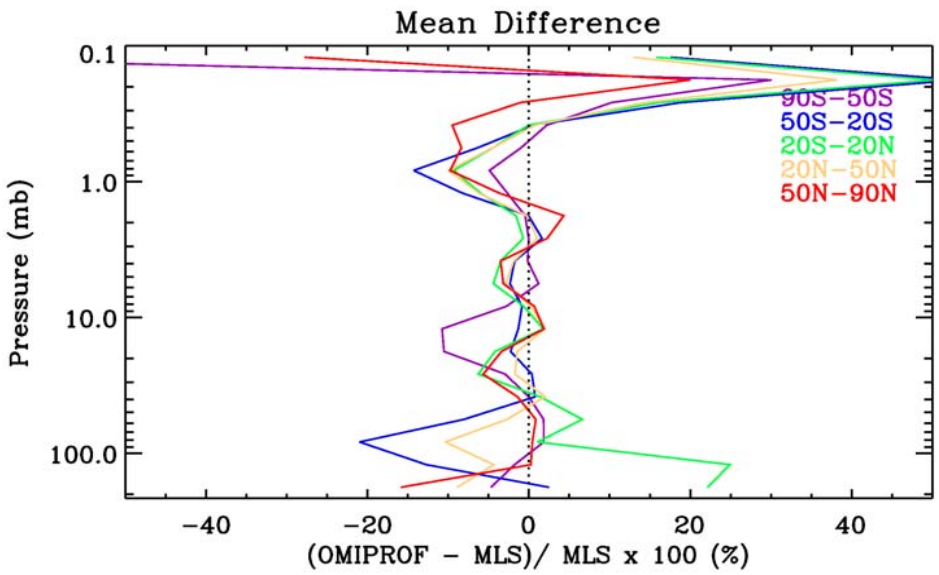
- **Retrieval algorithm**
  - Spectral fitting with the optimal estimation
  - 270-310 nm (UV1) and 310-330 nm (UV2)
  - Co-add 4 OMI pixels along the track, 52×48 km^2 at nadir
  - Apply across-track and wavelength-dependent correction to OMI normalized radiances

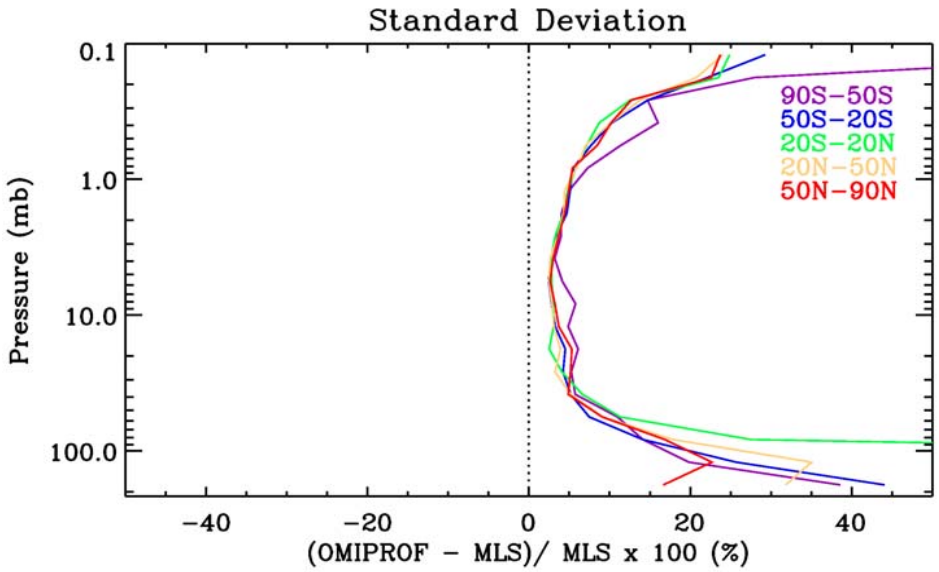
- **Validation with MLS data**
  - Apply all MLS quality flags
  - ~1100 MLS/OMI coincident pairs daily
  - No spatial averaging to match the spatial resolution
  - Not taken their different vertical resolutions into account

Comparison with MLS Stratospheric Ozone Profiles





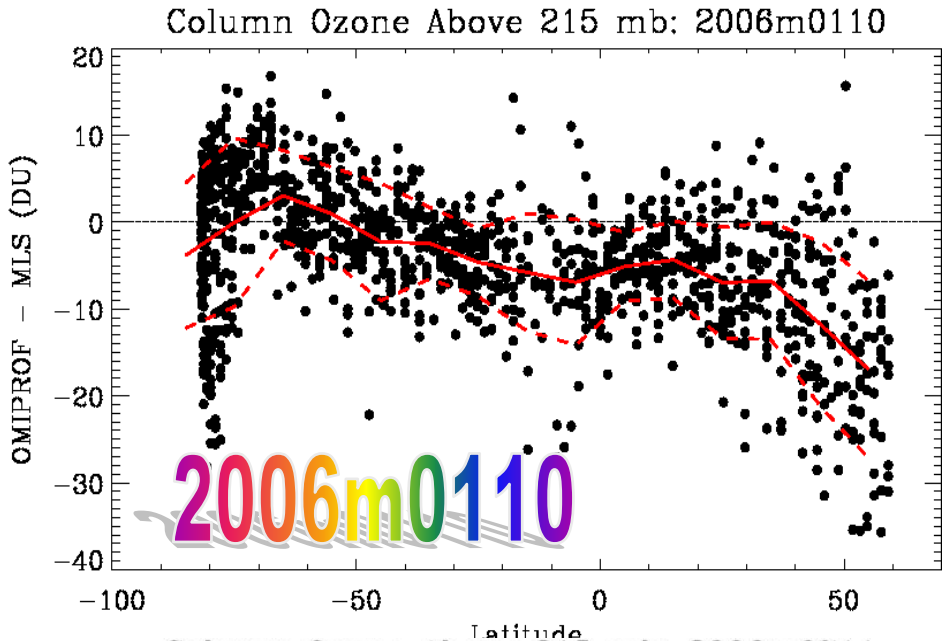


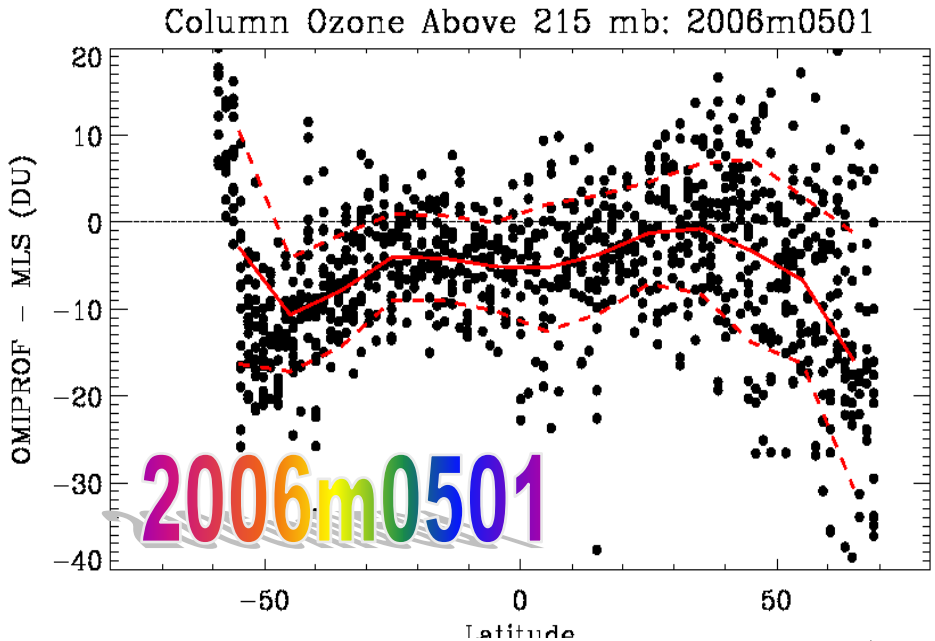


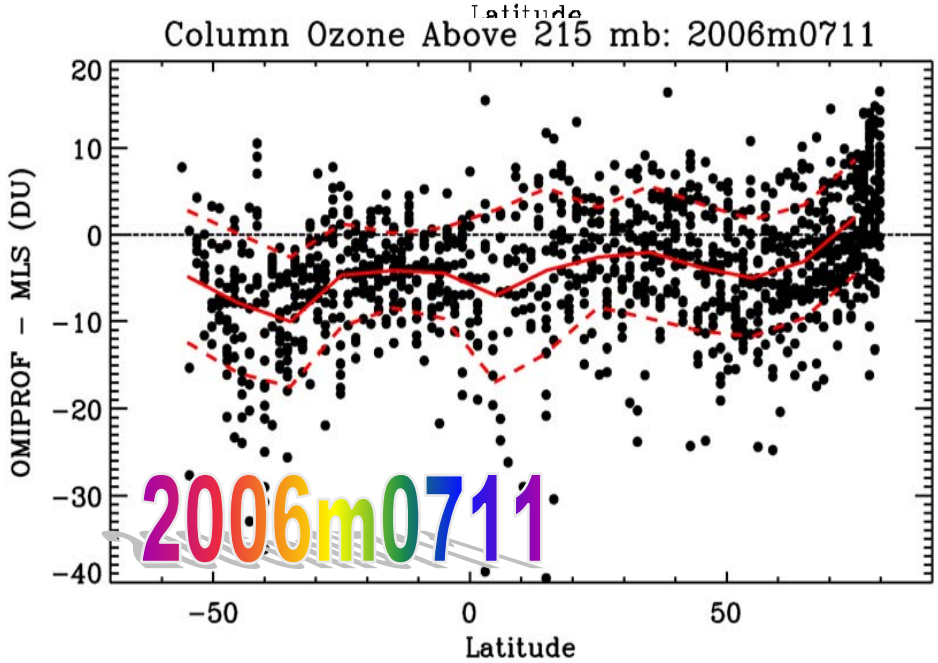
UV1, No Correction, 2006m0501

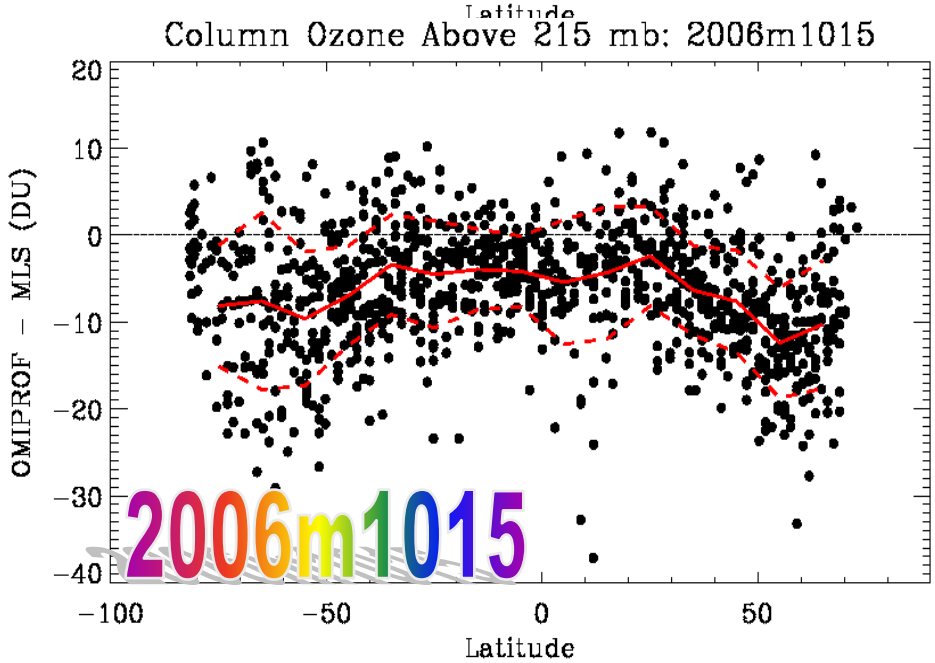
UV12, With Correction, 2006m0501

Validation of Column Ozone Above 215 mb

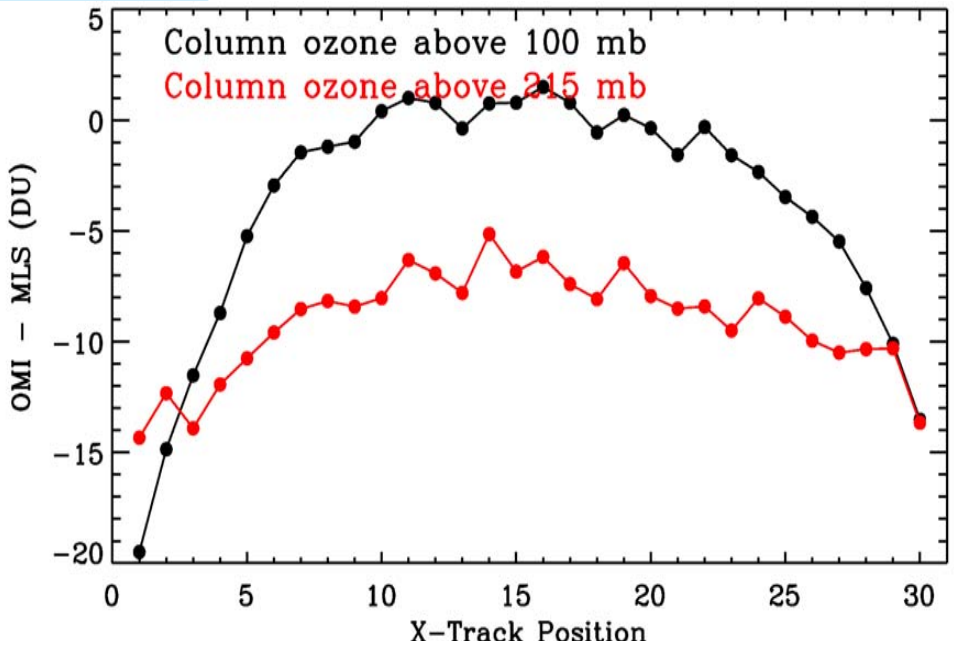




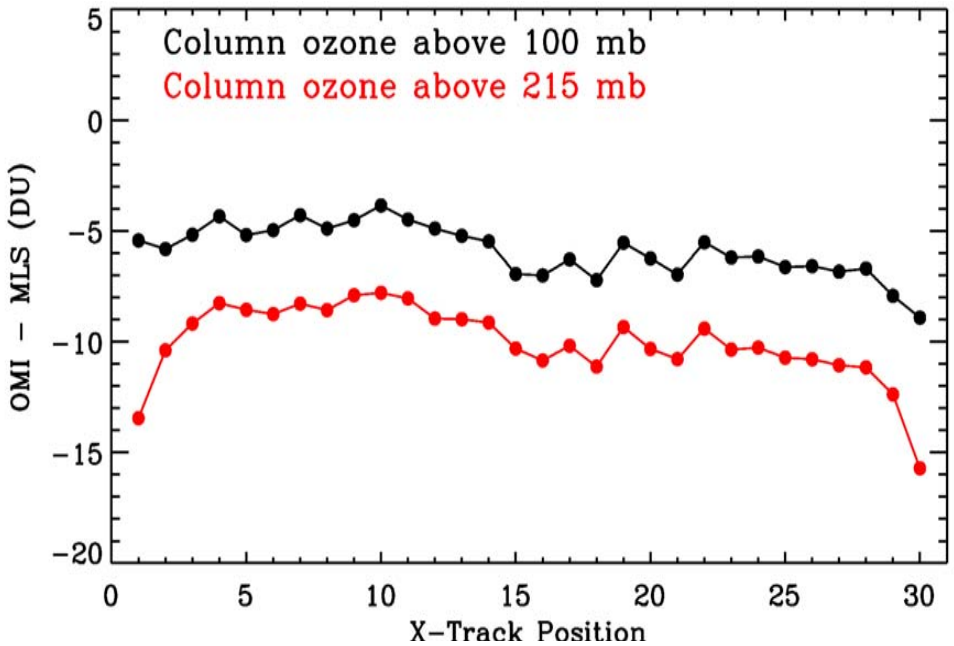




Validation of Column Ozone Above 100mb/215 mb



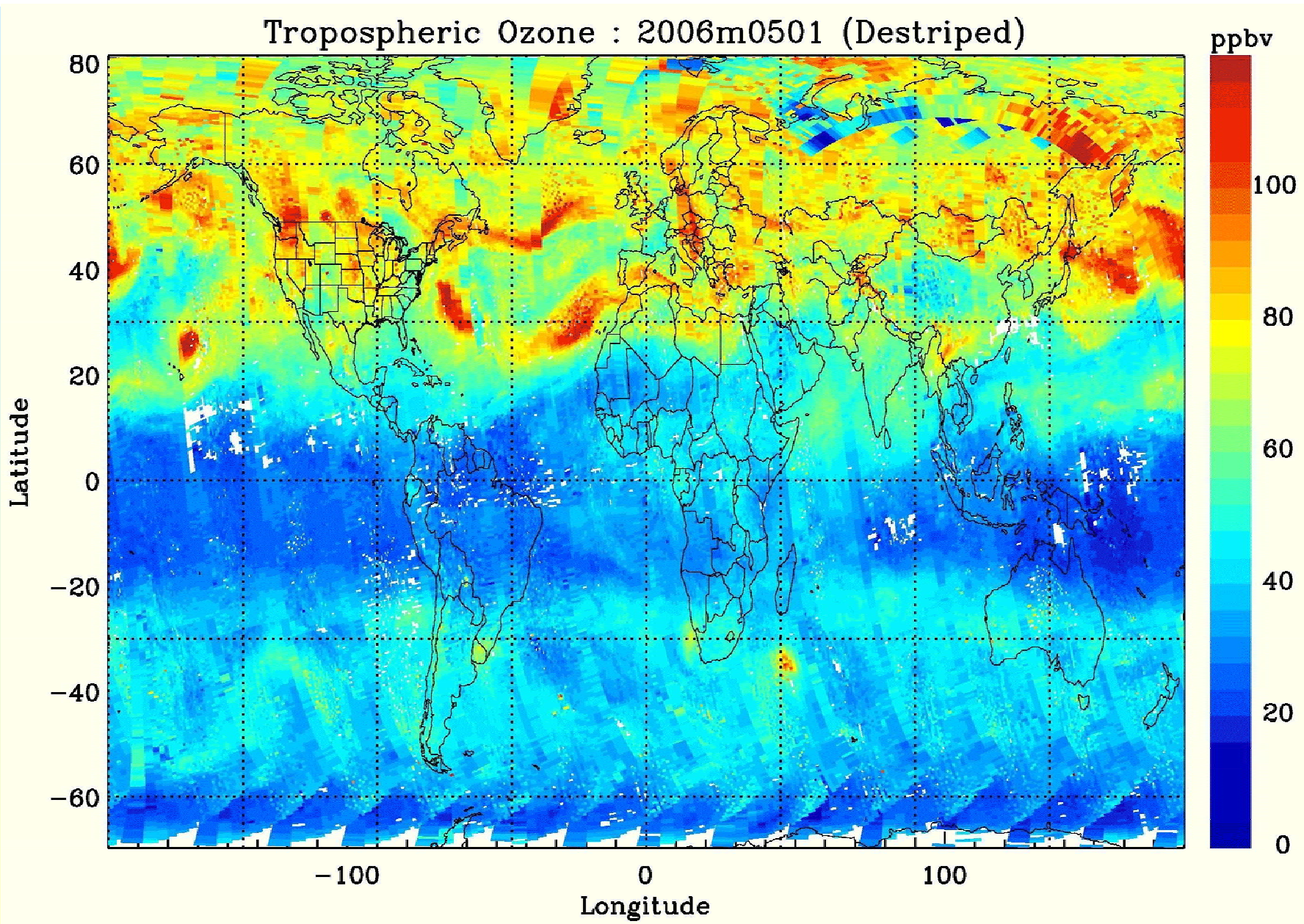
UV1, No Correction, 2006m0501



UV12, With Correction, 2006m0501

■ **Correction of OMI radiances significantly reduces the across-track dependent biases.**

Tropospheric Ozone Mixing Ratio (May 1 - May 9 2006)



Summary

- Identify across-track and wavelength dependent biases in OMI Level 1b data, discontinuity between UV1 and UV2 and possibly some wavelength calibration issues with the use of MLS data.

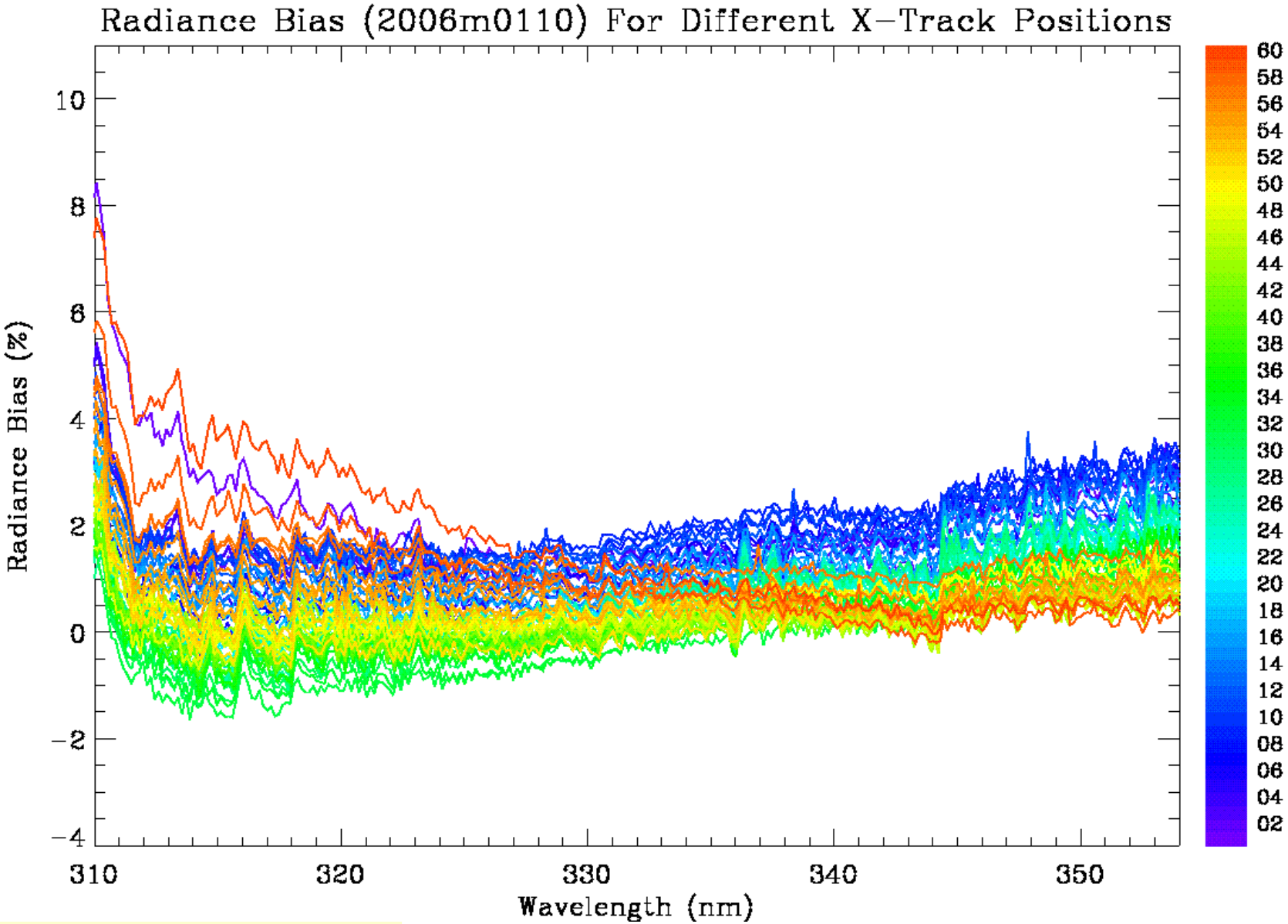
- Correction of OMI radiances (derived from tropics) improves the comparison with MLS data at all latitudes and reduces across-track dependent biases.

- The retrieved stratospheric ozone profile and stratospheric column ozone with correction compare well with MLS data to within uncertainties of both retrievals.

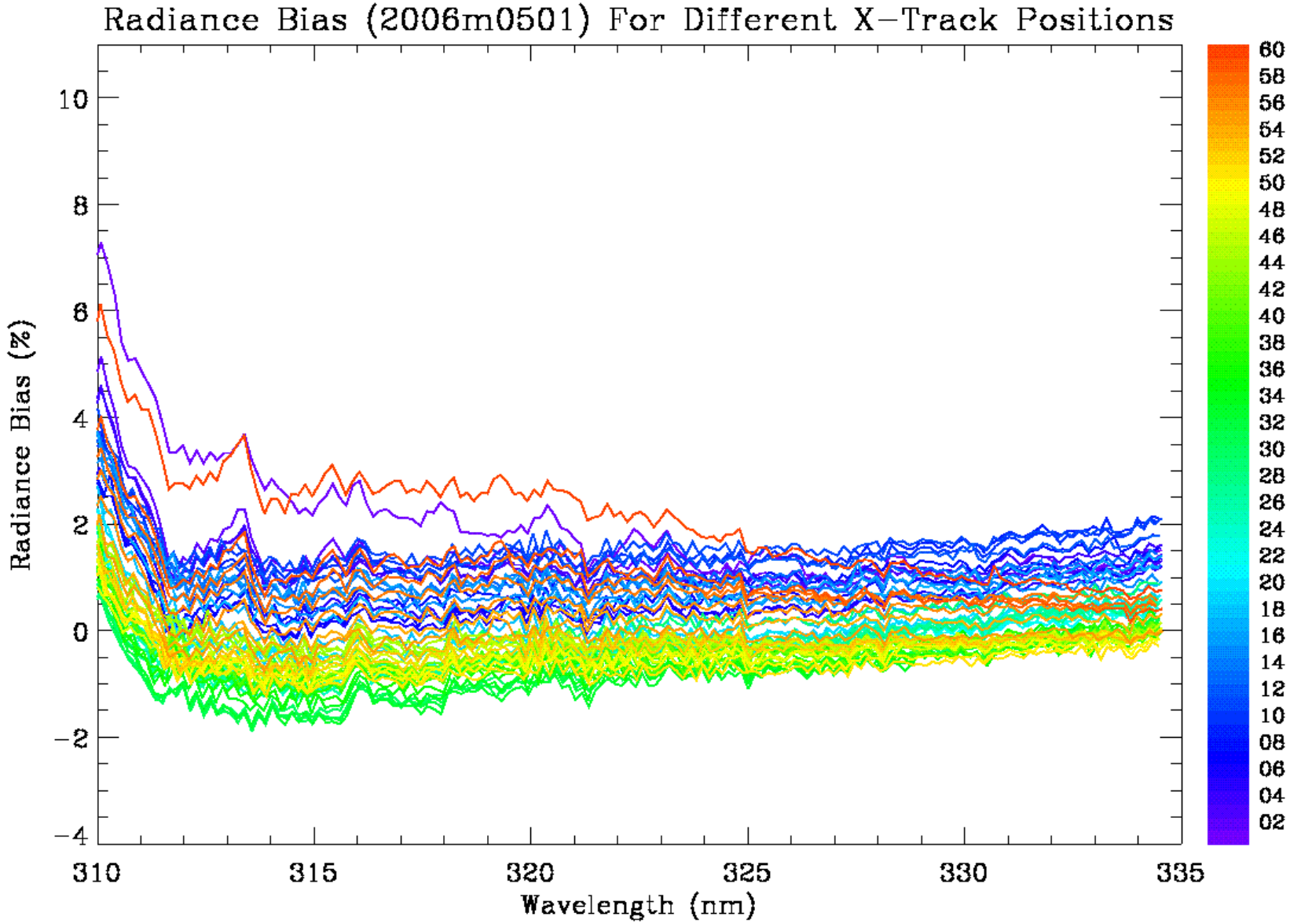
Acknowledgements:

- OMI Science Team, MLS Science Team
- Support from NASA
- Discussion with Joanna Joiner about OMI residuals

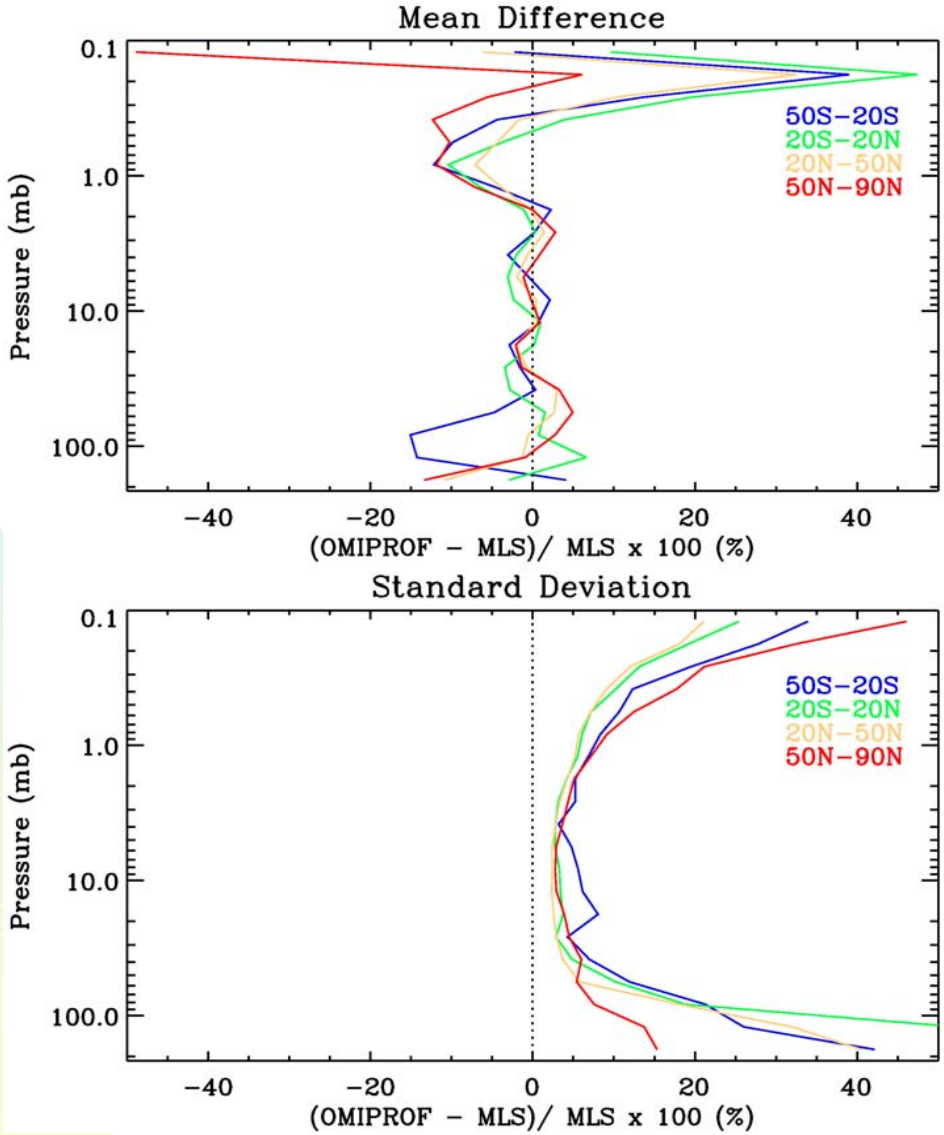
OMI Residuals (UV2, 309-355 nm, 2006m0110)



OMI Residuals (UV2, 309-335 nm, 2006m0501)

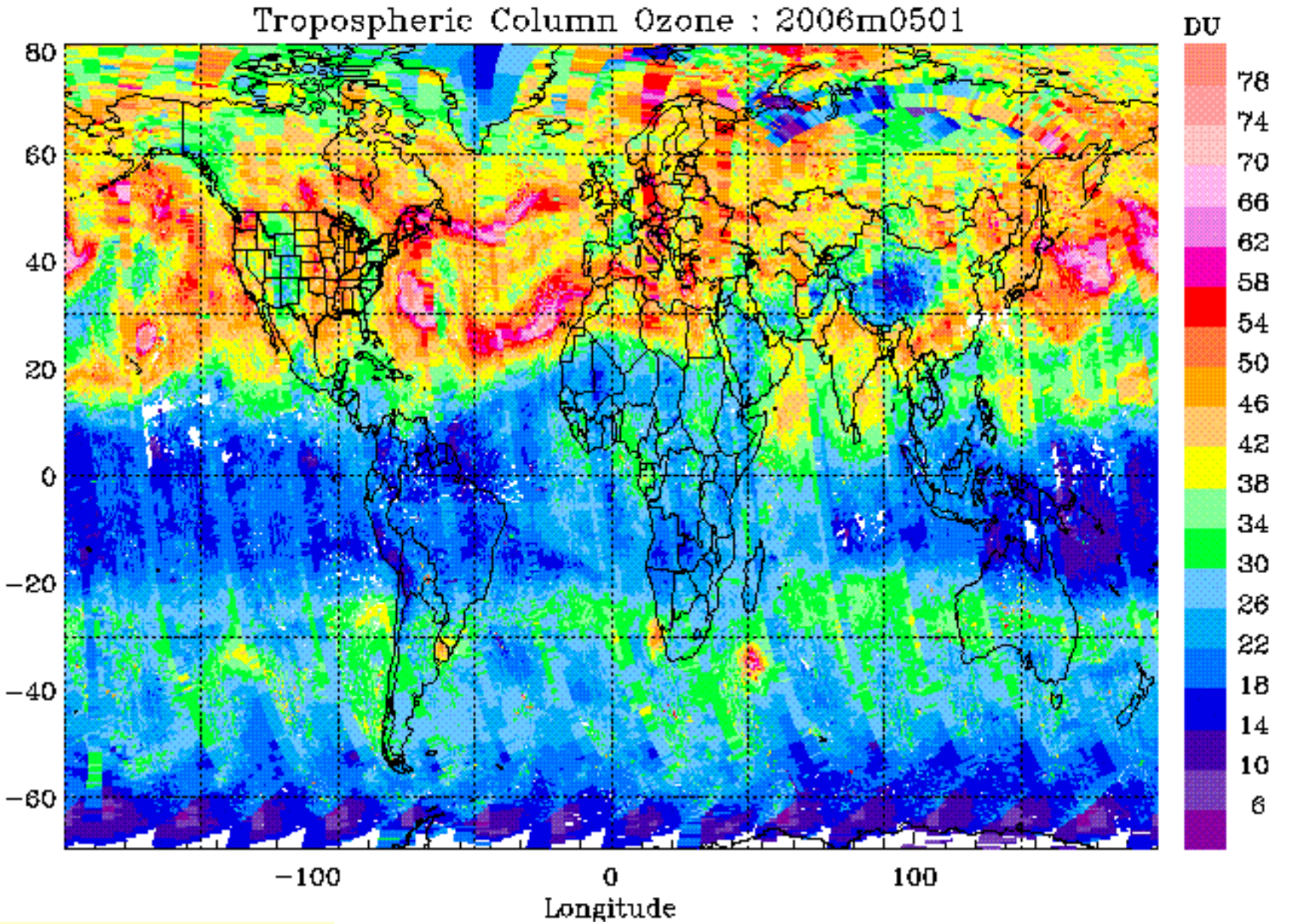


Comparison with MLS Stratospheric Ozone Profiles

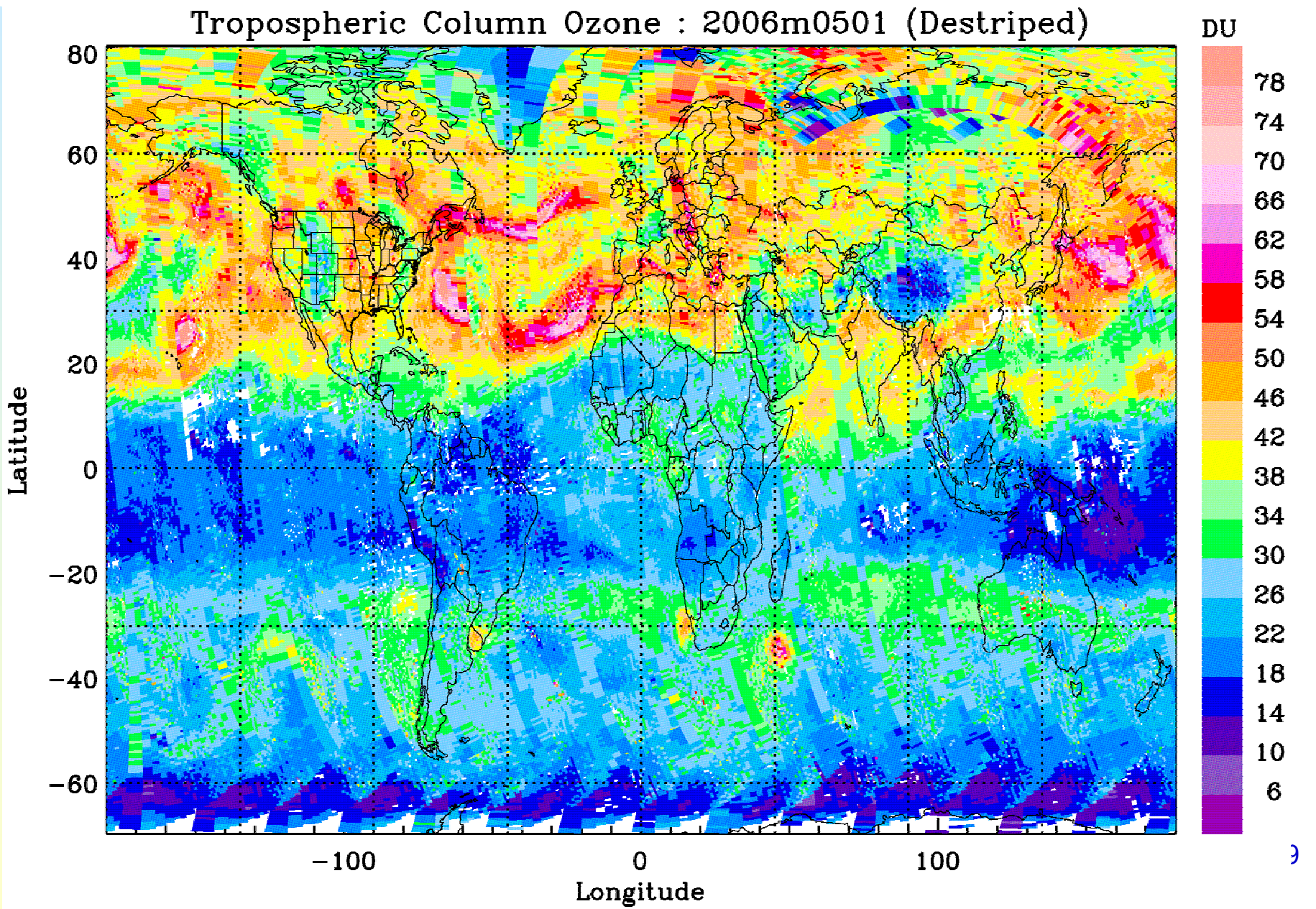


UV12, With Correction, 2006m0711

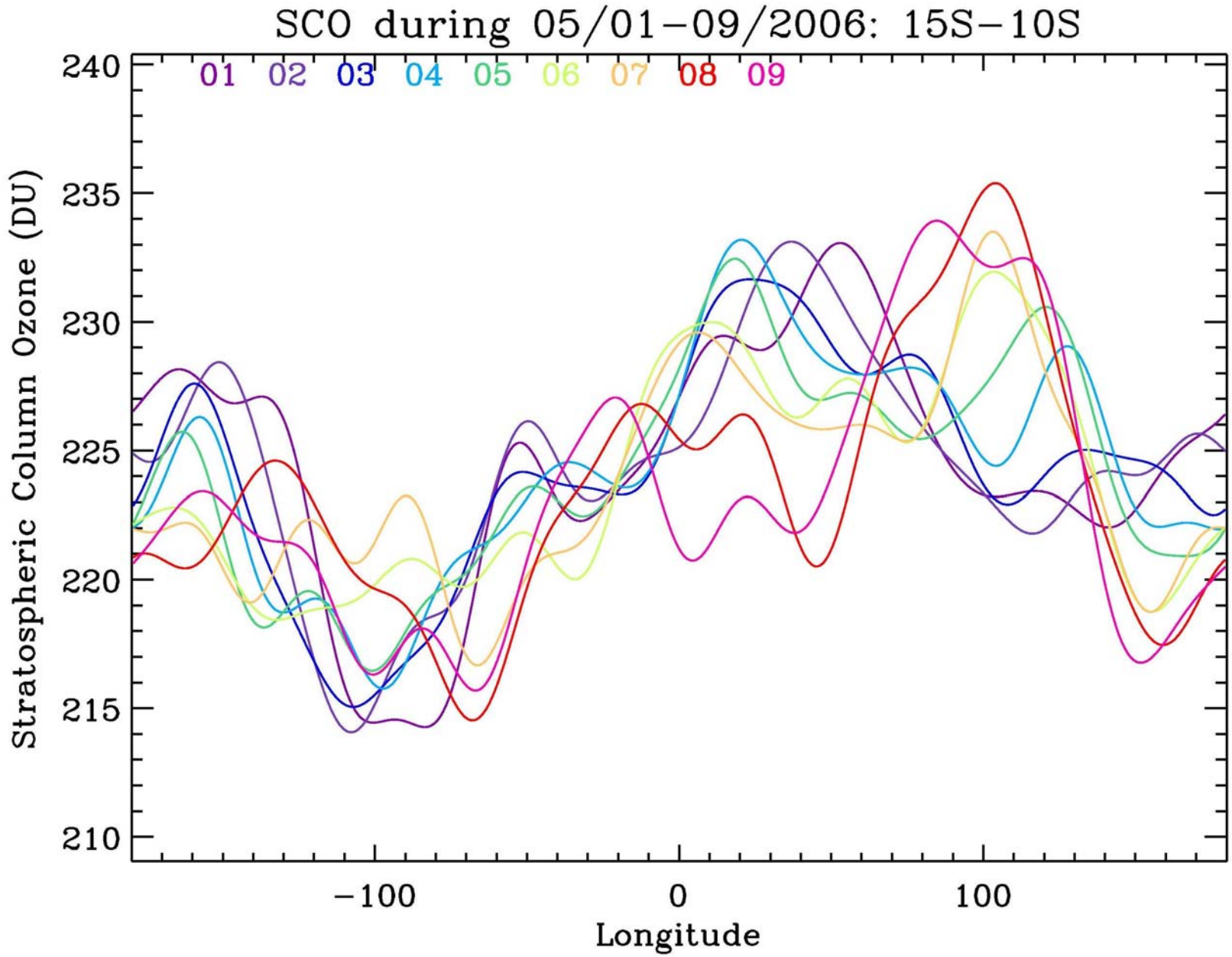
Tropospheric Column Ozone



Tropospheric Ozone Mixing Ratio (May 1 - May 9 2006)



Stratospheric Column Ozone



Stratospheric Column Ozone